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ABSTRACT

This report summarizes the current state of electronic theses and dissertations (ETDs). The introduction covers: an orientation to ETDs; the current situation; benefits of ETDs; key issues, including readiness, publication potential, intellectual property, orientation and training, standards, costs, access, archiving/preservation, and restrictions; and questions for planners. "Reports From the Field" focuses on current developments in the following institutions: Virginia Tech; West Virginia University; Cornell University (New York); Universite Laval (Quebec); College of William and Mary (Virginia); University of South Florida; University of Wisconsin; North Carolina State University; University of Texas; University of Toronto; Tri University Group (TUG), comprised of the University of Waterloo, University of Guelph, and Wilfrid Laurier University (Ontario); National Library of Canada; and University Microfilms International (UMI). Contact information is provided for all the programs discussed. Future trends in ETDs are considered, and a list of selected articles and World Wide Web sites is included. (DLS)

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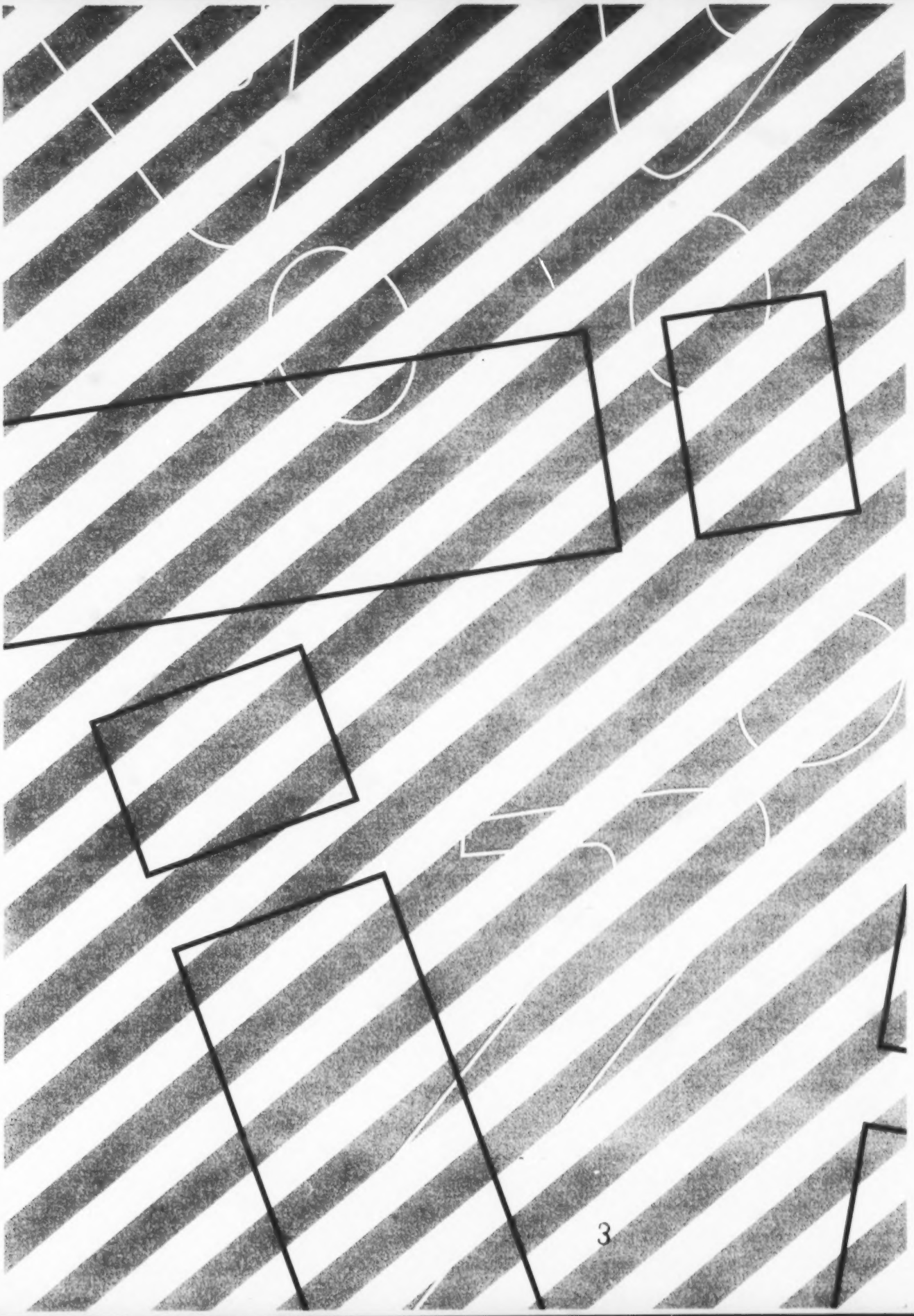

Electronic Theses and Dissertations

Transforming Libraries *Issues and Innovations in*

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Transforming Libraries
Issues and Innovations in
Electronic Theses and Dissertations
7

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Introduction: Electronic Theses and Dissertations

PERHAPS no technological development in recent years has so energized the academic community as electronic theses and dissertations (ETDs). Though only one university is currently in full production mode, with a second close behind, many others are running pilot projects or discussing the issues on their campuses. Some in academia are very strong advocates, pointing to clear benefits for all concerned, but others are not so sure, suggesting that ETDs may compromise the publication potential of student work.

This issue of *Transforming Libraries* summarizes the current state of ETDs and reports on current developments in thirteen institutions. The content is based primarily on interviews with twenty-one information professionals in fifteen institutions.

All interviewees contributed to the key issues sections of the issue. Special thanks are conveyed to Paul Gherman, Vanderbilt University; Phyllis Johnson, Nancy Szofran, and Lee Durham, Michigan Tech; Marty Crowe, Cornell; Gary Kreps and Berna Heyman, College of William and Mary; and Gail McMillan, Virginia Tech, who also served as Technical Advisor for this issue.

ETDs: A Brief Orientation

Though there are many variations among the ETD programs surveyed, there are also many similarities. ETDs are digitally produced, archived, and accessed theses and dissertations. Typically, students produce their work using standard word processing systems, then convert them into PDF or SGML formats. They may insert multimedia files: still pictures, maps, or video and audio clips, etc. The campus graduate school reviews the work for proper formatting and returns it to the student for corrections, if needed. The student's committee reviews and approves the work, at which point it is available to the library for processing and archiving. Students have a menu of choices for distribution; typically these

choices include 1) unrestricted distribution via the web; 2) distribution restricted to the University community; and 3) no distribution allowed for a certain period. The library catalogs the item and provides searching capabilities through programs such as free WAIS and OpenText. The ETD may be sent to a commercial service (e.g., UMI or OCLC) for archiving or access. The library may also retain duplicate paper and/or microfiche copies, though the ideal appears to be to move entirely to electronic forms.

The library's role in ETD programs varies widely. In some cases, the library has been the facilitator, stimulating discussion, forming partnerships, training students, and accepting electronic submissions. In others, the library plays a less prominent role, making traditional library contributions such as cataloging, archiving, etc. In some institutions, ETDs are viewed as part of a broader program of electronic publishing.

The Current Situation

One institution, Virginia Tech, is in full production mode with more than 1,100 ETDs approved so far. West Virginia University is the second institution to make electronic submission of theses and dissertations mandatory, effective August 1998. Several other institutions are in pilot mode, and many others are in the process of orienting their campus communities and/or investigating and discussing ETDs. Most are moving cautiously toward what is considered by many as the inevitable outcome: required submission of theses and dissertations in electronic form.

Virginia Tech is the clear leader in the field; they are viewed by many as setting standards for ETD programs. With grant support, they are providing training, software and other kinds of assistance to anyone who asks for it. The Networked Digital Library of Theses and Dissertations (NDLTD), based at Virginia Tech, is an umbrella organization of 35 institutions (as of July 1998) that are at various stages in the development of ETD programs. NDLTD acts as a clearinghouse for information about ETDs, holds discussions about ETDs with publishers, and promotes inquiry into ETD issues. There are a few proposed research and development projects related to ETDs: one seeks to coordinate resources for students and another is looking at differences in approaches to ETDs based on culture or size of institution.

Emerging partnerships and consensus characterize many local campus efforts. The most "advanced" efforts appear to have strong administrative champions, good relationships among key players (graduate school, library, academic computing, for example), and a

technology-friendly climate. Few institutions, however, seem ready to "cross the line"—that is, to require electronic submission—any time soon. Moreover, few appear to be gathering baseline data about ETDs or their current paper thesis system. Consequently, there appears to be much speculation but hardly any solid data on issues such as the impact of ETDs on publishing or whether ETDs will save money for institutions.

Benefits of ETDs

The benefits of ETDs are many. In general, they correlate with the benefits of most electronic services and resources:

- Accessibility from anywhere at any time.
- Quick availability after submission. Paper dissertations may take up to a year to be processed.
- Searchability, indexing.
- Inclusion of multimedia. Media can enhance the quality of the publication and are also seen as a key learning opportunity for students.
- Potential savings in storage space, circulation, interlibrary loan, and processing costs. Paper and microforms are comparatively cumbersome, costly media.
- Simplification of cataloging processes.
- Education of students in use of electronic technologies in scholarly inquiry and publication.

Key Issues

While the benefits of ETDs are vividly apparent, movement toward widespread adoption of fully developed ETD programs has been relatively slow. Libraries are grappling with several issues. As usual, the purely technical issues appear to be solvable, while the human issues look somewhat more daunting.

Readiness

The issue of readiness encompasses a great deal. For most, it means, "How ready is the institution to embrace ETDs such that electronic submission should be a requirement of the process?" Most institutions are answering, "Not yet ready!" For many, there

is not yet a critical mass of skills and positive attitudes. In general, though it is not invariably true, faculty and students in the sciences are more enthusiastic about ETDs than their colleagues in the social sciences and humanities. Scientists, by and large, are more experienced with electronic scholarship. Humanists and social scientists tend to be more concerned about loss of potential publication of their work and plagiarism. In some cases, student skills are not sufficient or the technical infrastructure is considered inadequate. One interviewee characterized the lack of readiness at his institution as a "combination of technophobia and insufficient staff." Finally, one person noted what the experts on change management tell us over and over about human nature: when confronted with significant change, people tend to focus on what they will lose rather than what they will gain.

Publication Potential

One of the thorniest issues for many students is the possibility that their chances of getting their work accepted by a publisher is compromised by electronic availability of their work. Several publishers have declared flatly that ETDs are considered previous publications and will not be accepted. But others (Elsevier, for example) have declared no blanket prohibition against ETDs, suggesting that individual editors would factor ETD availability in their publication decisions. One interviewee suggested their goal was definitely not to antagonize publishers. However, it is likely that publishers will be less skeptical once there is wider use of ETDs and more data on trends available.

Intellectual Property

As with any electronic publication, ETDs present property rights issues, even though ownership by the student and sponsorship by the university may seem to simplify the problems. Some are concerned that wider availability on the web will lead to plagiarism and irresponsible redistribution of their work. Some faculty have expressed concern that their own work, which is sometimes the framework for the student's work, will be prematurely released and not appropriately credited.

Orientation and Training

Institutions running ETD programs, whether in pilot or routine mode, have discovered that orientation and training need a great deal of attention and may represent significant additional cost. And though the grander aim of ETDs—to educate students in electronic scholarship—is often cited, training frequently boils

down to practical basics. Students need to be trained in systems such as PDF. Sometimes they even need basic training in word processing. The decision concerning who will provide training for students is a key one for planners. The Library? The Computing Center? The Graduate School? Peer trainers have been found by some institutions to be very effective. In general, interviewees spoke of greater success with informal training methods, and spoke of the importance of having staff available to assist students when they needed special help. Peer orientations have been found to be equally important for engaging faculty in ETD discussions. One university has recruited the Head of the English Department as an effective spokesperson for ETDs. Another is trying to reach all administrators and faculty in groups of 25 to 30 each.

Standards

"ETDs are different," declared one interviewee. "We can get all 'glowy' about their benefits and forget that they represent a difficult transition for many in our community." Choice of formats can be troublesome, especially when students are creating their work in everything from state-of-the-art systems to antique word processing systems. Planners need to decide what standards they will set for electronic submission and how much responsibility they will place on the student for meeting standards. One university is planning to accept any current, conventional word processing system and convert it for the student; others are requiring submission in a single format. Several people expressed concern about choosing standards such as PDF, which is a proprietary system. Others expressed concern about the additional costs to students if they buy their own software to create PDF files. Standards determine how computer labs will be equipped, what systems trainers have to master and how difficult it will be to manage files.

Costs

Opinions about costs are very much divided here. Some feel that ETDs, though a tremendous improvement in service, will not result in appreciable overall cost-savings; others feel that considerable savings will result. Still others point to significant start-up costs. It seems undeniable that there will be savings in some areas for those institutions that migrate to required electronic submission; for libraries, such savings should be found in storage, processing, and interlibrary lending, as well as other areas. And yet, until the top of the learning curve is reached, training of students might represent significant additional costs.

For some institutions, there will be an initial outlay for hardware and software, student support, etc.

Access

A key benefit of electronic publishing is the potential for indexing, even at the full-text level. Institutions need to decide how fully they will index: Will they maintain links within ETDs? Full-text indexing requires additional machine storage: will additional servers be required? One intriguing aspect of the indexing question, now being explored by a few institutions, is whether students will be enlisted to provide key words, index terms, and other metadata for their own work. This could, of course, speed up processing enormously, but also cause inconsistencies in retrieval systems.

Archiving, Preservation

Archiving and preservation are a major issues for most interviewees. The challenges of digital preservation were explored in *Transforming Libraries* #5; they are no less daunting in the area of ETDs. Eventually, institutions will have to solve a problem that hangs over the entire scholarly enterprise: How will we preserve digitally created information when the lifespan of electronic systems is so short compared to the durability of print? Some institutions are moving forward, trusting that technological solutions will be found, while others remain cautious and are not committing to archiving. Many are committed to running parallel paper/microform systems or to relying on UMI as an archival holding.

Restrictions

Many institutions will provide students a menu of distribution choices, including the option of restricting access to the campus or denying access altogether. Yet some have begun to question restrictions and to work toward refinements. A critical question for state institutions is whether they can, by law, keep the citizens of their states from accessing the products of university research. One institution has found that restricting access to the campus cuts off the ability to send copies when they are requested through conventional interlibrary loan channels. Discovering the implications of restrictions will continue to challenge those who plan ETD programs.

Questions for Planners

The issues raised by ETDs translate into several questions for campus planners as they consider whether to begin an ETD program.

1. How ready is your campus? Is there sufficient buy-in at administrative levels? Are there faculty who will be supportive? Not all faculty have to be on board, but it helps to have some senior faculty and a good representation from the various disciplines. Is there a viable test-bed—that is, a Graduate School or a few departments that will participate in a pilot project? Is your technical infrastructure sufficient? Will you be able to recruit graduate students to participate in a pilot project?
2. What are your goals? To enhance graduate education by preparing students for skilled participation in electronic forms of research and publication? To save money? To enhance service? To provide content for your institution's virtual library?
3. Will you mount a pilot project or move as quickly as possible into routine required submission mode? There are strong arguments for both options. Most institutions will choose pilots, primarily as a means of orienting campus stakeholders to ETDs, but also to test various aspects of ETD programs before moving into required submission. On the other hand, those who have moved with relative speed into ETDs as a routine production mode report that this has stimulated creativity and learning.
4. Will you choose a model for adaptation, or will you develop your own program from scratch? The Virginia Tech model and the support available from the NDLTD are irresistible to many institutions thinking about ETDs.
5. How will you manage orientation to ETDs and training of students and faculty on your campus? Top-down approaches, even enthusiastic supportive ones, have usually met with some resistance. Will you be able to enlist peers for orientations: faculty for faculty, students for students? Who will do the training? The library, the computer center, the graduate school?

Will responsibilities be divided? What are the goals of training? To make students as independent as possible?

6. How will you manage archiving, preservation? By maintaining parallel backup systems? By outsourcing archival management? What sort of commitment to preservation will you make to students?

7. How will you handle questions and concerns about diminished publication potential? How candid will you be with students about the possibility that some publishers might reject their work for publication if it has been distributed as an ETD?

8. What standards or limitations will you set? Will you accept all formats, all multimedia files? Some institutions have decided to accept everything as a way of putting their technical systems to the test. Others have limited the formats that will be accepted: only certain word processing systems, only PDF files, or no exotic multimedia files. Some are accepting only dissertations, not theses.

9. What menu of distribution choices will you offer? Full availability on the web? Availability limited to the campus? Possibility of closed access?

10. Will you analyze costs and resource requirements? Will you try to get a handle on costs for current non-ETD processes for baseline comparisons?

11. What kinds of access will you provide for ETDs? Full text indexing? Standard cataloging? Will you ask students to provide metadata, especially key words, with their electronic submissions?

Reports from the Field

THIRTEEN institutions are represented in the **Reports from the Field**, ranging from two institutions that have begun requiring electronic submission of ETDs through a number that are in pilot or exploratory mode. UMI's perspective is also provided.

For many, Virginia Tech serves as a model for how ETDs can and should be managed. West Virginia University has just made electronic submissions mandatory: their experiences at this early stage will be especially interesting to those institutions considering ETDs.

Cornell's planning document for an ETD program provides a model framework for how careful planning can be assembled. Université Laval is focusing on the goal of making ETD preparation as easy as possible for students while making it a true learning experience for them as well. The College of William and Mary is running a small demonstration pilot project while working out policy issues at the campus-wide level. The University of South Florida sees ETDs as an important part of their distance learning programs and is collaborating with other institutions on a research and development project. The University of Wisconsin is carefully assembling the infrastructure needed for an ETD program. North Carolina State is working on a number of fronts, but focusing on building and maintaining a strong partnership between the library and the Graduate School. The University of Texas' program is seen as an integral part of their overall electronic publishing effort.

Three reports, in addition to the Université Laval, come out of Canadian institutions. The University of Toronto, working with York University, is focusing on technical standards, workflow, and the impact of ETDs on publishing. The Waterloo, Guelph, and Wilfrid Laurier Universities have joined forces as the Tri Universities Group (TUG) to mount a consortial approach to ETDs. And the National Library of Canada provides an interesting model of a national approach to managing ETDs.

Finally, no survey of ETDs would be complete without reference to UMI, whose role with respect to ETDs is still emerging but promises to be a key one.

Virginia Tech Leads the Way

Virginia Tech (VT) exerts powerful leadership in the area of electronic theses and dissertations. It was the first institution to require that students submit theses and dissertations in electronic form, and it is the founding institution for the Networked Digital Library of Theses and Dissertations (NDLTD). With grant support, VT provides free services to institutions in both exploratory and pilot phases: software, orientation, training modules, public relations materials, and advice. Many interviewees for this project applauded the generosity with which VT has made its resources available in the cause of advancing ETDs.

The record is impressive. Five years after beginning their exploration of ETDs, VT has mounted more than 1,100 of them. These include 500 still image files, 50 sound files, and 37 movie files. One online dissertation has been consulted more than 9,000 times. Only one piece of paper is still required in the ETD process: the official document that the student's committee signs.

With so many dissertations and theses mounted, says VT's Gail McMillan, they are very much out of pilot mode and into routine production. They have, in fact, entered a period of tweaking and improving the program. Currently, for example, they are working on the submission process, developing a system that will convert elements from the student's submission form into catalog record elements.

They are also taking time to analyze the data. Almost everyone who has read about ETDs knows that VT students have three options for distribution of their work: 1) no access; 2) access limited to the VT campus; and 3) full access by the world on the web. So far, only 20% have chosen no access, 33% campus-only access, and 47% full Internet access. VT is looking at a further refinement of the options: providing different levels of access for different parts of dissertations. One problem with the campus-only option, notes McMillan, is that Interlibrary Loan is curtailed: therefore they are working on changing the policy to incorporate direct author-reader interaction through e-mail links and conventional ILL. Moreover, the Graduate School is considering a follow-up study with authors to see if they are noticing any impact from having their work available electronically.

One decision under consideration is changing the default for

longer term restrictions on access. Currently, restricted access is good for one year, after which the Graduate School contacts the author asking for permission to make the work available. Under the new plan, restricted ETDs could become universally available after two years unless students notify VT that they want the restrictions to stay in effect.

With so much experience with VT's own program and with other members of the NDLTD, Gail McMillan is in an excellent position to comment on the ingredients for a successful ETD program. She feels that having a centralized Graduate School—an entity to channel communication and planning through—makes a big positive difference. Leadership is a crucial factor: if key campus administrators are not ready for ETDs, the idea will have little hope of success. And yet, though support from the top is important, the decision to implement an ETD program should never be a top-down decision. Too much is at stake for graduate students and faculty. Often a critical factor has been the library taking a decisive action: creating a web site, putting up sample files, and talking with faculty and students.

Virginia Tech's Faculty Development Initiative has been an especially important factor. For new and returning faculty, there is a clear expectation that they become technologically literate and use technology in their work with students. Thus each faculty member not only receives state-of-the-art computer resources from the University, but also intensive training in the use of them. Finally, McMillan finds that peer support for students—students training other students—has made a big difference.

Copyright and archiving are still key issues at VT. They continue to talk with publishers, hoping to convince them that online availability of ETDs should not impact the publication process. Nonetheless, they are candid with students and advise them to talk with potential publishers before making a decision to make their work available on the web. Archiving electronic files is still a thorny issue, but is, of course, a problem not unique to ETDs. McMillan is confident that enough good minds are at work on the problem that it will be solved eventually.

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West Virginia University Takes the Plunge

Beginning in August 1998, West Virginia University was the second U. S. institution, after Virginia Tech, to require students to submit dissertations and theses in electronic form. The West Virginia program is modeled after Virginia Tech's, and they also received planning assistance from Virginia Tech. Other positive factors include a campus administration that has been very supportive of the effort as well as a small campus-wide committee that has kept planning on target at the same time that they communicate fully with student and faculty stakeholders. An important factor is the culture of West Virginia, which is accepting of new technological approaches. Finally, the effort was marked by a very inclusive, hands-on approach to building support.

Workshops to train students in ETD submission began in the spring of 1998, but educational efforts have been underway for some time on the campus. These early presentations were made at all levels to groups of 25 to 30 people at a time—deans, faculty, students. Typically, faculty were brought in to make the presentations and thus lend credibility to the project. This peer approach was especially important in winning over faculty.

The responsibility for training students has been divided between Academic Computing, which focuses on thesis and dissertation preparation, and the Library, which focuses on access to electronic dissertations. Training tasks have been mostly absorbed by existing staff: only one additional student has been hired by the Library to work on the ETD website.

Students are given a menu of submission options similar to Virginia Tech's. However, WVU is considering providing ETD access to all state residents regardless of the distribution option chosen by students.

To address some of the campus concerns about preservation, WVU is planning to maintain three electronic copies of theses and dissertations: a service copy on campus, a second copy in an off-campus electronic storage facility, and a third copy at UMI, on whom they will depend to handle requests for sales of their dissertations.

Librarian Ruth Nellis was engaged early in the ETD planning process by the Dean of Libraries and a Provost who wanted to move the initiative forward. One key to success has been that the Committee assigned to plan for ETDs moved the process along while still engaging in lively discussion of the issues. In fact, the group deliberately sought out those who might have serious concerns about ETDs and engaged allies such as the Head of the

English Department to make presentations to faculty groups. Basically, says Nellis, they dealt with issues in a thorough, iterative process—and then moved ahead. One of the key issues for faculty, as in many other settings, was the concern that publishers might reject work based on theses and dissertations that were already available to the world in electronic form. As time went by, however, stakeholders began to see that there were more similarities between traditional paper systems and ETDs—and that specifically there was little danger of electronic availability compromising future publishing potential.

Another apparently favorable factor is decentralized graduate studies at WVU. Graduate programs are administered in the colleges and departments. Nellis feels that this may have been an important factor in managing resistance to ETDs.

Finally, the WVU website provides access to a wealth of resources to students and faculty in the form of frequently asked questions and materials describing the purposes and benefits of the ETD program.

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Cornell Provides Comprehensive Planning Model

Sarah Thomas, University Librarian, chairs Cornell University's Electronic Publishing Steering Committee, which has been charged with developing a coherent strategy for all electronic publishing at Cornell. The possibilities range broadly. Collaboration with scholarly societies to create and distribute scholarly information, a preprint discussion service, and a Land Grant Digital Press are just some of the ideas being discussed. ETDs are being conceived of as part of this campus-wide effort, and the Library has become a major player in planning for ETD.

To further develop ETDs at Cornell, Associate Librarian Marty Crowe compiled a report that provides an informative summary of previous work done by projects such as the Networked Digital Library of Theses and Dissertations (NDLTD), as well as the status of ETDs at cohort institutions, including MIT, Illinois, and Michigan, as well as the work of UMI in this area.

Of special interest to readers will be a detailed section on technical requirements and costs. For example, it is estimated that hardware and software for serving ETDs will cost around $21,000,

and 0.75 FTE new staff will be needed in the Library. Costs for the Graduate School (more thesis advisement staff and peer student assistants) are mentioned but not estimated. Archiving considerations receive special attention, as do storage requirements and radical differences in processing. The latter is especially promising. Crowe notes that "the submission form filled in by the student could be designed so that the metadata map directly to a MARC record. . . Students would be encouraged to include keywords with their submission data so that fields could be generated on the record to create subject access. In addition, the abstract could be included in the catalog record. There would no longer be a circulation copy to security strip, bookmark, or shelve; the entire process would be streamlined."

One key finding of the study: electronic submission might in fact be cheaper for students than the present Cornell system. Overall, however, the conclusion is that ETDs "will not be an immediate cost-saving venture for either the Library or the University—it will be a service."

Though Crowe cautions that her report is "Cornell-specific," it clearly serves as a model for the investigative framework for developing ETD programs.

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Université Laval Focuses on Ease of Use for Students

Université Laval is participating in a seminal project whose aim is to integrate scholarly communication throughout Quebec. This project was initiated by the Université Montreal Library to link all theses and dissertations produced in the province of Quebec. Gilbert Babin points out that, although the Université Laval is following the trail blazed by Virginia Tech in planning its electronic theses program, there is one significant difference: graduate students will be able to produce their theses in conventional word processing formats.

Babin, Associate Professor in the Département d'informatique, chairs the Working Group on Electronic Theses that is currently implementing a pilot project to test the feasibility of electronic theses.

The pilot project has three major goals: 1) to identify and solve technical and policy problems in an electronic theses program,

2) to recommend on the feasibility of the electronic theses program to the Graduate School, and 3) to plan for implementation of a fully electronic program in the year 2000.

The pilot project has five distinct phases: design, promotion, training, actual thesis writing, and translator development.

Design. Design choices have already been made. The driving technical choice was to use SGML as the archiving format for theses since it is easiest for the Library in its archival program. However, students will not have to know SGML. Though they will need to use a standard style sheet and will need further training in the capabilities of their existing systems, they will be able to work with their preferred word processing system. The archival SGML format will enable creation of files in HTML, PDF, and XML, which will be the formats for access to the theses. Though paper copies of theses will be generated for use during the thesis review process, eventually all theses will be in electronic format. One further design element: for the pilot, designers have focused on text only; they will tackle images, sound, video, and other formats, as they move further into implementation.

Promotion. Graduate students in two departments and one school who are close to completing their theses have received personal written invitations from the Dean of Graduate Studies to participate in the pilot. The working group is hoping for a participation rate of 40-60%. The departments (Computer Science and Electrical Engineering) and the school (Business Administration) represent a spectrum of students, from those who are computer literate to those who do not have sophisticated computer skills. The computer-savvy students will be able to provide informed feedback on technical aspects of the pilot, while the less sophisticated users will help the designers understand the technical support challenges that they must meet in working with a diverse student population.

Training. Since students will be using a word processing system with which most are already familiar, training focuses not on learning another system but on learning the full functionality of the system they already know and on the semantics of thesis form: citations, chapters, paragraphs, etc. The concept behind this approach is that students will master the important intellectual content of scholarly discourse while they are preparing to submit an electronic thesis.

Thesis Writing. The skills learned during the training phase will guide the actual writing of student theses.

Translator Development. Running parallel to the previous four phases will be development of translators—programs that will translate text from the word processing systems in which it is

submitted to SGML and from SGML to the output formats (HTML, PDF, XML).

As in Virginia Tech's program, once the Laval program is fully implemented each student will have a menu of choices in making her or his work available to the rest of the world: 1) to make the theses available to everyone on the Internet, 2) to restrict availability to the Laval campus community for a set period of time, 3) to postpone availability both to the Laval campus and the Internet for a set period of time, and 4) to make part of the thesis available and part not (in case, for example, the research has been done under the sponsorship of a government agency and is classified).

The University Library has been heavily involved in development of the project, and among the primary motivators is the need to cut down on the library's shelving and archiving costs. In fact, says Babin, this approach will probably neither lighten nor make heavier the burden of writing and formatting that the student already bears in the thesis preparation process, though their effort will have a much more substantial long-range benefit in his view. He points out that most people use only a small subset of the functionality of the systems available to them; Laval wants to make this capability as large as possible for their graduate students. They hope to prepare students to be fully "tooled" in the capabilities of their word-processing systems—fully ready to conduct discourse in their chosen scholarly community.

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William and Mary Moves Cautiously Toward ETDs

The College of William and Mary has been planning the transition to ETDs for years, and though planners are sometimes frustrated with the slow progress, they are convinced that, for them, the slow but sure route is the best. From the beginning, the effort has been buttressed by a strong partnership between the Swem Library and the campus Information Technology Division.

So far, the main campus has mounted a pilot project, coordinated by Berna Heyman in the Library and Dennis Aebersold, Vice-President for Information Technology. At the same time, Virginia Institute of Marine Science (VIMS) Librarian Chuck

McFadden has experimented with the technology of ETDs, mounting them in marine science as demonstration projects. The College has also identified the key issues related to ETDs and made recommendations on how to resolve these.

William and Mary's planning process was led by Gary Kreps, Associate Provost for Academic Affairs. In February of 1998, a team of eight people produced a report laying out the technology, the benefits, the issues, and what needs to happen next. The vision is admirable: "In preparing students for scholarship in the twenty-first century, we have the opportunity to both encourage and train our students to adopt and create new forms of scholarly communication." Issues are identified in a straightforward manner. Regarding intellectual property, the report insists that it be acknowledged that the creators of the work—the students—retain complete rights. At the same time, it is acknowledged that "commercial publishers remain concerned about the disincentives of unrestricted electronic access. Student and faculty concerns about the impact of ETDs on academic credentialing are no less apparent, given the importance of publishing articles and monographs for academic employment, tenure, and promotion." On this last issue, William and Mary has tried to examine the data: how many ETDs are actually published in part or whole? How many authors are denied publication because their work exists in electronic form? So far, they haven't found any statistics to support concerns that ETDs interfere with the scholarly publication process.

Probable resource requirements are laid out clearly: software for producing PDF files or DVIs (device independent) files must be provided in computer labs; personnel will need to be allocated to train students in the use of scanners, graphic creation, and multimedia technologies, as well as one-on-one assistance; cataloging, archiving, storage, and system backup also need to be funded.

Though still in pilot mode, the College is actively planning. They will probably soon add undergraduate honors theses to their ETD program. They are also engaging students in the process of developing work forms for bibliographic entries, whether submissions are in electronic form or not. One aspect of the current plan is a safety net: the Library is taking full responsibility for electronic archiving and will retain a duplicate paper collection of theses and dissertations for the time being.

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The University of South Florida Sees ETDs as Part of Larger Digital Project

The University of South Florida is ideally situated to develop its burgeoning ETD program: with a central campus and large main library in Tampa, it serves satellite campuses in its region and administers several distance learning programs. Campus administrators are very much technologically oriented, as are the University's libraries. With 34,000 students, mostly commuters, it was natural that the library be taken to the users via electronic means.

ETDs are seen as a primary means of providing important content for the Virtual Library Project, which includes a number of other efforts. Sub-projects around which library teams have been developed include ETDs, marketing, staff training and development, digitization, interface design, electronic reserves, and document delivery.

USF will not, for the foreseeable future, require students to submit theses and dissertations in electronic form, though they have opened up the possibility of doing so on a voluntary basis. The feeling among key decision makers is that there is much potential for loss of good will on the campus were they to mandate electronic submission. The Graduate School in particular wants to make sure that ETDs evolve as a natural, painless process for students. Ultimately, however, the University does have an interest in holding onto the output of its students, making it easily available to the world.

In the meantime, USF is partnering with the University of Virginia and Virginia Tech in a project that is currently in the grant application phase. The project seeks to "research the effects of web-based authoring tools and knowledge networks on the ETDs produced by graduate students in engineering and science, which number in the tens of thousands each year." The first step will be to create ETDRE (Electronic Theses and Dissertation Resource Environment), a single, integrated web authoring resource offering

"web-based software tools, online help, and a digital library of relevant reference resources." The proposed project has been endorsed by Southeastern Universities Research Association (SURA), the National Library of Canada, and the Coalition for Networked Information (CNI), among others. Though existing software will be used or adapted, new tools will be developed to meet the needs of engineering and science students.

The study proposes to find answers to important questions that many universities are asking about ETDs: How will graduate students and faculty use ETDRE? How will it affect the students' composing process? What is required as a multimedia development resource for students? How might ETDRE improve graduate education? How will it enable interdisciplinary work?

For universities and libraries seeking baseline information and practical tools related to ETDs, this study holds much promise.

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The University of Wisconsin Examines Key Issues

In December of 1997, the University of Wisconsin-Madison's Electronic Dissertation Submission Committee was constituted with twenty members representing a variety of stakeholders, including the Library. The Committee's charge is to function as "the means by which [the University] will be able to investigate and establish procedures and implementation of electronic deposit of dissertations on this campus." From the beginning, says Librarian Peter Gorman, the Committee has been marked by its focus, its relatively peaceful discussion of the issues, and its rational, problem-solving approach to ETDs, though he admits that, when ETDs begin to be discussed on the whole campus, some of the classic issues and their associated conflicts may emerge.

Like many other Universities, Wisconsin is taking a measured approach to ETDs, targeting spring of 1999 as the time when they

will begin to accept dissertations in electronic format submitted on a voluntary basis. They are focusing on dissertations, as there is not a requirement that Masters students deposit their theses.

Several issues have surfaced. For the Library, a key question is what formats they will accept. SGML would be preferred, but with authoring software costing approximately $750.00 per package it is still a very expensive purchase for most students. In the short term, PDF files will be accepted. Yet, though they are easier for students to produce, they require special viewing tools and their indexing capabilities are constrained. Related to format acceptance is the issue of indexing. Will indexing be done at the abstract level only or at the full text level? As the processing and storage costs associated with full-text indexing are considerable, this is an important fiscal question. Another technical issue is security of the server on which ETDs will reside. Since students will be able to submit materials directly to the Library's computers, authentication and protection become challenges that will need to be worked out.

The campus-wide committee is focusing primarily on training and support for 750 dissertation students annually. They are projecting the need for additional staffing to handle these tasks, which will be managed primarily by the Graduate School and the academic departments. The perceived "skittishness" of publishers is another issue under discussion. Though some publishers appear to be comfortable with electronic publication of dissertations, others see it as a preempting of the publication process, even suggesting that they will not consider a dissertation for publication that is available in electronic form, even if it has been modified for publication. The committee believes that these concerns will decrease over time, as both universities and publishers have more experience with electronic publication. In the meantime, they are advising students to contact publishers in advance of electronic submission.

A related issue being explored is whether the university, as a state institution, can delay or limit distribution of dissertations in any format (for example, if a patent is involved). Though the electronic medium offers new options for phased access as a means to placate publishers' fears, there may be overriding legal or policy concerns, which would argue for a continuation of the existing access model for print publication of dissertations.

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Partnership with the Graduate School in NCSU Pilot

The Department for Digital Library Initiatives of the North Carolina State University Libraries often functions like a research and development unit in a company, according to Doris Sigl, Librarian for the Organization of Networked Resources. Part of the department's mission is to keep up with technological developments, think creatively about new technological applications, and develop working models for digital products and services such as reserves and electronic theses and dissertations.

The NC State pilot project on ETDs started in 1996 with a visit by the team from Virginia Tech. Cooperation between the Graduate School and the Libraries led to recruitment of a dozen student volunteers in the spring of 1997. Project personnel showed the students a demonstration, talked with them about the project, and did a great deal of listening. Not all the students were enthusiastic: only four signed on initially. Currently, however, NC State has twelve theses and dissertations mounted electronically.

In this pilot phase, some publicity has occurred through the Graduate Student Association and other campus channels. However, the current ETD program has most often been "marketed" through the Graduate School's Thesis Editor. In monthly thesis preparation workshops, she encourages students to consider submitting their work electronically. According to Sigl, the project's chief lesson has been about the need for support of students as they go through the process of completing an ETD. In several cases, students have tried to submit their work in many multiple files that are not correctly linked, and they have had to be coached through the process of resubmitting their files. Other students have had difficulty locating the Adobe Acrobat software.

The Library is focusing on the immediate practical issues of maintaining the ETD software, acquiring ETDs, cataloging them, and mounting them on the web, as well as on the long-term issues of electronic archiving. Meanwhile, a Graduate School committee is looking at the broader campus issues, including the question of whether to require that students submit their work electronically, whether a paper submission will still be required, what it will take to develop an operational program, whether appropriate software is available at all campus computing labs, what kinds of communication and training systems need to be developed, and what partnerships need to be forged with other campus units such as Information Technology.

Sigl has found that her own background as a librarian, with her understanding of the MARC format and web-based library systems,

has helped immensely in the development of this ETD project. Within the DRA web-based OPAC, the Libraries are able to provide users easy movement from the bibliographic citation for an ETD to an abstract and then to the full document. They will also investigate the application of metadata to ETDs.

Though the technical issues involved in the Library's management of ETDs are significant, the real challenges reside in the profound changes in the educational process represented by ETDs. In a sense, the Library is doing—albeit in new ways—what it has always done: acquiring, cataloging, archiving, and making information accessible. The significant change is for students, who must learn to present their research in profoundly different ways. Partnering with the Graduate School has therefore become critically important, especially with the faculty. Though students are often willing to try electronic submission of their work, faculty can be less enthusiastic, often because they fear that such easy access to their students' work may not be in the students' best interest.

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ETDs Part of Larger Electronic Publishing Effort at the University of Texas

As the publishing arm of the General Libraries of the University of Texas Library, the Electronic Information Programs Division encompasses a wide range of electronic publications, not just ETDs.

With ETDs, Mark McFarland, the Division's Head Librarian, acknowledges that they are moving cautiously. Currently, working within the framework of the Networked Digital Library of Theses and Dissertations (NDLTD), they are setting up a prototype system that students may use to submit their dissertations electronically. They are not accepting masters theses in electronic format yet because of the overall complexity of managing large, media-rich files. The current pilot project is aimed at identifying ten to twenty willing dissertation authors and using their work as the basis for specifying the major components of an ETD system for a campus that publishes as many as 750 dissertations a year.

The Division has software in place and is at this point working with students in a pilot mode. An administrative module has been developed for review by the Graduate School and other key

stakeholders. Though submissions in PDF are encouraged, they can accept other formats.

Preservation is a key concern for the Library. Though they are developing standard strategies, such as refreshing files, they are being very straightforward with students: they are not guaranteeing students that everything will still be available in ten years, pointing to analogous deterioration of paper formats. They are especially cautious in their commitment to preserve formats that are experiencing great technological change, such as motion video.

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The University of Toronto Library Focuses on Standards and Workflow

Like many libraries, the University of Toronto Library, working with the National Library of Canada (NLC), is still building infrastructure for an ETD program. Currently, NLC has a contract with UMI to microfilm all dissertations from members of the Canadian Thesis Program. That UMI accepts theses and dissertations in electronic format is seen as a strong plus in the program.

With one of the largest and most diverse student bodies in North America, the University of Toronto feels the need to move cautiously with electronic submission. Therefore, they are examining the key issues in ETD implementation.

One important issue is standards. Librarian Joseph Desjardins would like to see SGML, rather than PDF, become the standard means by which students submit their work for two important reasons. First, PDF is a proprietary system, and this translates into uncertainties for long-term issues such as preservation. Second, PDF is much more limited in its indexing capabilities than SGML.

The interest in standards has a basis in real problem analysis. In conducting a test, they received eight volunteer submissions from students. One even arrived formatted in WordStar, a word processing system few people remember, much less use. Even with more recent formats, there were problems converting the work into usable form.

Toronto partnered with York University in workflow analyses in order to gain baseline data about current paper processes. Both universities, though they used different analytical methods, found

that it typically took a year to get a paper thesis or dissertation to the shelves from the moment of submission. Some delays are located in the graduate schools, but some were also found in the Library's operations. Desjardins hopes that delays attributed to handling physical materials can be reduced by simply printing copies of electronic theses and dissertations. Processes can be further aided if students are able to help out, for example by including subject terms in their submissions.

In preparing to "go electronic," the University of Toronto has also looked at potential impact of ETDs on the publishing industry, including the issue of whether easy availability of ETDs on the web will result in loss of potential revenue for students. Their conclusion is that none of the negative outcomes commonly projected these days are likely to happen, mainly because the filtering process provided by publication (e.g., anonymous peer review) will continue to be important. Scholarly inquiry will continue, they believe, to prefer refereed publications.

Though Toronto has not yet conducted cost studies, they project that ETDs will enhance access and reduce turnaround time but are not likely to result in substantial savings.

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TUG Builds Understanding, Tests Infrastructure

The University of Waterloo is collaborating with the University of Guelph and Wilfrid Laurier University (the Tri University Group, or TUG) in an ETD program, the goals of which "are to develop procedures that will allow electronic submission of theses and to develop a database that will allow electronic access to theses." This joint project evolved from a pilot project at Waterloo.

The focus of the pilot was on distribution rather than submission, specifically on how well the PDF format would work for them. As a first step in the project, a list of issues was developed through a survey of users. Then a system test was run, which involved mounting seventeen theses for Internet access. To challenge the system, they sought a range of thesis types, from older works published in the 1960s to a recent electronic thesis with challenging graphics.

Findings indicated that older materials take a great deal of time to load, an important consideration for institutions wanting to

archive thousands of pre-electronic theses and dissertations. More recent items, especially those formatted in standard, current word processing systems, were much easier to work with. Challenges were also encountered with more "esoteric" systems, such as LaTeX, a word processing format used frequently in scientific work. PDF was found to be a good format for distribution but probably not for submission of ETDs. One incidental projection is that photocopy costs for students will be reduced considerably when electronic submission is an option. It is expected that TUG students will have the option of submitting their work in PostScript format, either as an attachment to an e-mail message or through ftp.

TUG has decided not to take on responsibility for long-term preservation of ETDs at this point, relying on the thesis archive maintained by the National Library of Canada. In communicating with faculty and students, they are being careful to state that preservation efforts will cover what is already available through the NLC: preservation in microfiche.

Christine Jewell describes the current effort as "building understanding." TUG is not in a hurry to require electronic submission: they will begin accepting electronic versions on a voluntary basis in January 1999. For a long while, they anticipate maintaining a dual system.

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National Library of Canada's Theses Service in Transition

The National Library of Canada (NLC) is a coordinating agency for dissertations and theses produced by Canadian universities. David Balatti, who manages NLC's Bibliographic Services, of which the Theses Service is a small (1.5 FTE) part, indicates that NLC is still defining its role in the national program as it migrates to the electronic era. Operationally, the role is clear: the NLC has a contract with UMI, which is responsible for archiving and providing access to Canadian theses and dissertations. The bulk of this work still occurs in traditional microform, but UMI also accepts electronic theses.

Readiness for ETDs among Canadian institutions varies greatly, according to Balatti. There is much interest in and discussion about the topic, but very few institutions are actually in production mode. Most are in a reactive mode, waiting and seeing what will happen to

determine the best options for their institutions; some have insufficient infrastructures to handle ETDs.

Roles for the NLC may include setting standards for submission and format. There may also be a role in coordinating cost studies. As in other exploratory ETD efforts, projections of cost savings vary greatly. For the moment, the agency functions as a clearinghouse for information and discussion, and, of course, coordinates the national program through its contract with UMI.

Though Balatti envisions great improvement in access through mounting dissertations and theses electronically, he also points with pride to already enhanced access provided in the current system—for example, inclusion of theses and dissertations in the national database, AMICUS, and the products that are derived from AMICUS.

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UMI Retains Its Leadership by Adapting, Developing New Approaches

These days, the UMI website, ProQuest Digital Dissertations, looks almost as lively as Amazon.com. With 80,000 dissertations and the last two years of the Dissertation Abstracts database available, a researcher has a great deal to choose from. Citations and abstracts can be looked at for free, and if you like an item you throw it in your virtual shopping cart or arrange to have a PDF file downloaded to your computer in about five minutes.

Universities that subscribe to UMI's services can retrieve anything they want (PDF downloads) from among their own institution's dissertations from 1997 forward, and anyone can access Current Research @. . ., an institution-specific database that will provide citations and abstracts to dissertations that come out of particular universities, also from 1997 forward. For subscribing universities, institution-specific databases provide searchable citations and abstracts back to 1861, and they link back to the institution's web site.

UMI's largest provider is the National Library of Canada (see page 31), which coordinates dissertation and thesis management in Canada, an undertaking that involves some 4,000 dissertations and 7,000 theses annually. NLC is currently gaining permission from Canadian graduate schools to put their dissertations and theses in digital form and make them available over the web just like U. S. dissertations.

UMI, in partnership with the University of California, Berkeley, and Howard University, is undertaking a study of the differences in how people in university settings search for, access, and use information in digital format: Are there cultural differences in information use? Does size of institution have an effect?

The position of UMI dissertation publishing is one of the issues that recurs in any discussion of ETDs. Scholars recognize the importance of UMI's creation and maintenance of a permanent archive of graduate research over much of this century. And UMI is acutely aware of the competition posed by ETDs. With a business model in which revenues are tied directly to copy sales, they are trying to keep prices affordable: they anticipate that for some time there will continue to be a viable market for paper copies sold at barely more than twenty dollars apiece. By staying competitive and fresh in its approach to the dissertation market, UMI expects to be in this business for a long time.

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ETDs: The Future

VIRTUALLY all interviewees felt that electronic theses and dissertations are an inevitable development. Though many institutions are taking it slow, their ultimate goal, clearly, is required submission of ETDs and, ultimately, a paperless thesis and dissertation program.

There are other likely developments. Costs associated with start-up and ongoing maintenance of ETD programs will probably continue to decline as part of the continuing moderation of hardware and software prices. Even personnel costs—for example, those associated with training—may decline as students entering the ETD process are more skilled technically.

Publishers are likely to soften their currently rigid stances on ETDs as more data become available on the impact of ETDs on traditional publication.

More and more students are likely to choose the most liberal option for distribution, full availability on the web.

Digital preservation is a much larger issue than the production of ETDs. Models for outsourced preservation, such as those provided by UMI, OCLC, and RLG, are likely to develop further and to be used, especially by smaller institutions that cannot provide their own electronic preservation programs.

Training will continue to be a strong need in ETD programs, at least until the next generation of computer savvy students hits graduate school. Orientation and training may begin to be focused on undergraduates, even some high school students, as graduate training and ETDs become more commonplace in the educational system.

Many say that as students become more technically adept and more creative in their approaches, we can expect a virtual explosion of value-added multimedia in ETDs. This will be an especially important development to watch, as costs for managing multimedia files—storage, preservation, and cataloging—can be very high.

It is also likely that we will see much more creativity in the use of links in ETDs, which may bring up new issues concerning standards and intellectual property.

Further study is needed on ETDs, resulting in real data to help formulate policies and decisions. We need to understand better the relationship between ETDs and their effect on the publishing market. We need to understand costs better, perhaps beginning with what we are currently spending to maintain paper systems.

Much like the larger world of electronic publication, ETDs represent major changes and major challenges to established ways of doing things. In this case, the benefits seem so heavily to outweigh any negative aspects that the widespread implementation of ETD programs does indeed seem inevitable.

Selected Resources for Further Study

Published articles

Three brief articles provide good summaries of the issues. Other articles and letters have appeared in *The Chronicle of Higher Education* (http://www.chronicle.merit.edu/>) and *The New York Times* (<http://www.nytimes.com/>), both of which can be searched online.

McMillan, Gail. "Electronic Theses and Dissertations: Merging Perspectives." *Cataloging and Classification Quarterly* 22.3-4 (1996): 105-125.

Orlans, Harold. "Potpourri: Theses on the Internet." *Change* 29.6 (Nov./Dec. 1997): 6-8.

Young, Jeffrey R. "Requiring Theses in Digital Form: The First Year at Virginia Tech." *Chronicle of Higher Education* 19 Feb. 1998: A29.

Websites

Much of the most useful information on ETDs can be found on websites. Readers are encouraged to browse the following:

Crowe, Martha J. *Publication of Electronic Dissertations*. 26 May 1998. Cornell University Library. 25 Aug. 1998 <http://www.library.cornell.edu/staffweb/ETDSTUDY.HTML>.

ETD Task Force. *Electronic Publication of Theses and Dissertations*. Report to Donna Dickerson, Interim Dean, Graduate School. Spring 1997. University of South Florida. 25 Aug. 1998 <http://www.usf.edu/~writing/etdreport.html>.

ETD Project: The Joint Electronic Thesis and Dissertation Project of the Faculty of Information Studies at the University of Toronto, University of Toronto Libraries, and York University. Faculty of Information Studies, University of Toronto. 25 Aug. 1998 <http://www.fis.utoronto.ca/etd/project.htm>.

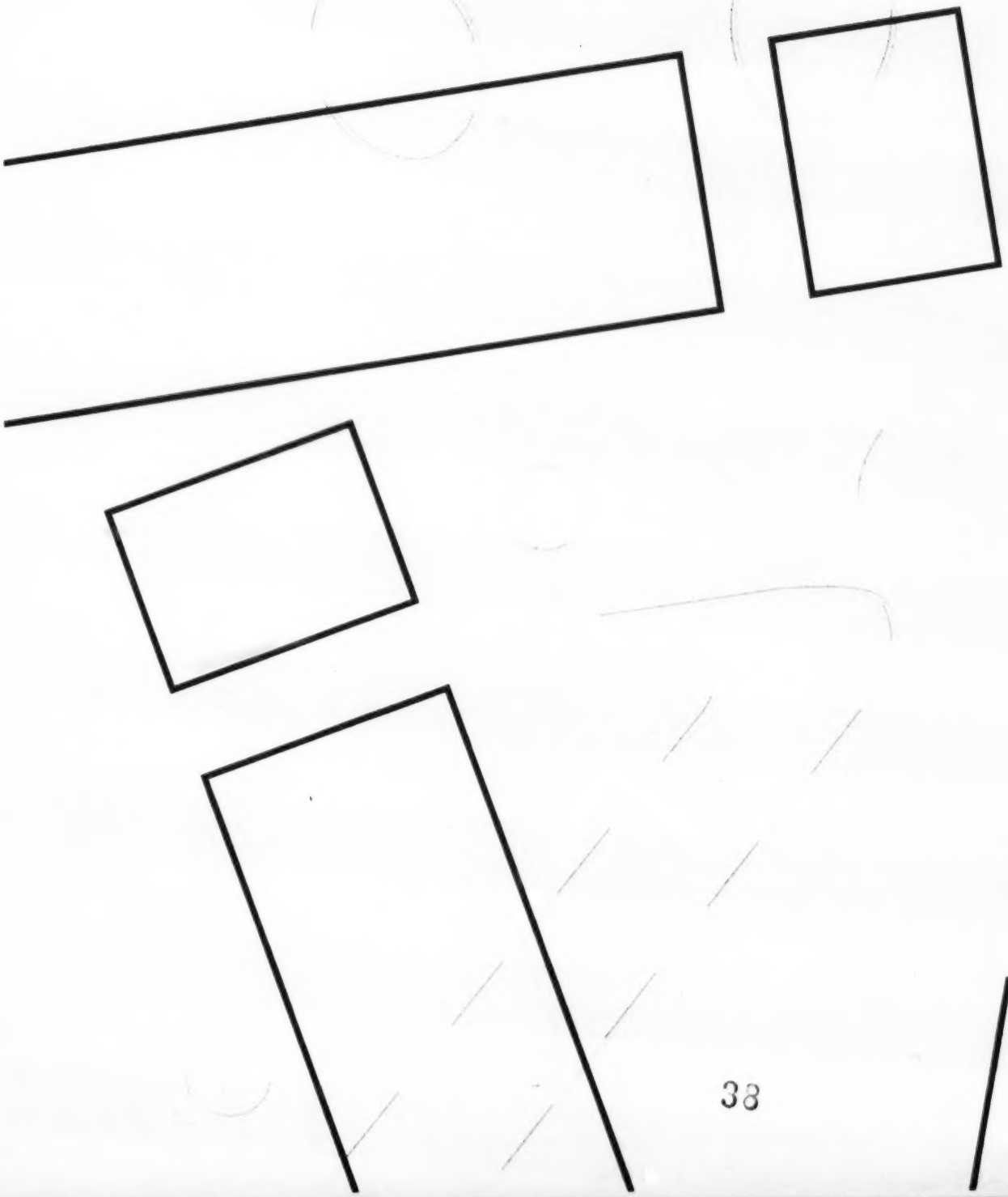
Networked Digital Library of Theses and Dissertations. 25 Aug. 1998 <http://www.ndltd.org/>.

Scholarly Communications Project. University Libraries, Virginia Tech. 25 Aug. 1998 <http://scholar.lib.vt.edu/thesis/>.

Tri University Group (TUG). *TUG Electronic Thesis Project*. Apr. 1998. University of Waterloo Library. 25 Aug. 1998 <http://www.lib.uwaterloo.ca/TUG/ETD/>.

Forthcoming:

Fox, Edward A., Joseph M. Moxley, and Christian R. Weisser, eds. *The Electronic Theses and Dissertations Sourcebook*. Forthcoming from Scarecrow Press.



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